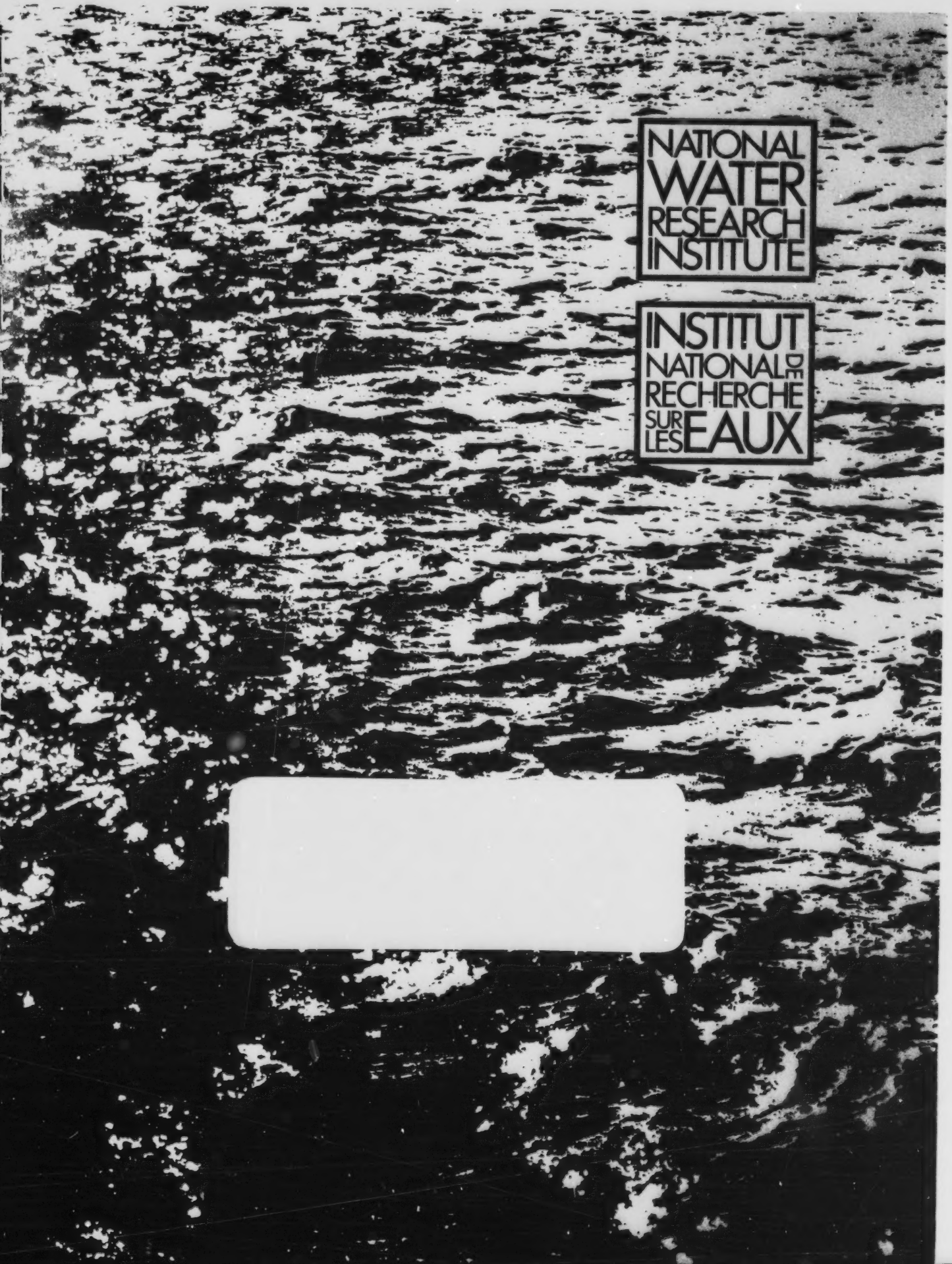
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RESEARCH AND APPLICATIONS BRANCH
SIX MONTH PROGRESS REPORT

1987 - 88

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To: Clients and Collaborators:

I am pleased to present a Six-Month Progress Report on the work of the Research and Applications Branch, National Water Research Institute.

The Scientists and Technologists of the Branch join with me in recognizing the support and stimulation provided by our many partners in these Research and Development initiatives.

We look forward to your comments and suggestions as we take on new challenges in our three special areas:

Analytical Chemistry Research
Quality Assurance
Hydraulics Studies

John Lawrence
Director
Research and Applications Branch

RESEARCH AND APPLICATIONS BRANCH
SIX-MONTH PROGRESS REPORT
1987-88

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RESEARCH AND APPLICATIONS BRANCH

John Lawrence, B.Sc., Ph.D., Director

OVERVIEW

The Research and Applications Branch of the National Water Research Institute conducts mission oriented basic and applied research in areas of analytical chemistry and hydraulics. It is also responsible for transferring research and technology to the operational sectors of the Department and for providing technical and scientific services such as current meter calibration, sedimentology and geotechnical services and analytical quality assurance. The work addresses priority issues of the Inland Waters/Lands Directorate and other agencies of the Department.

New, improved and more cost effective analytical techniques (including laboratory automation) are developed and evaluated for the measurement of priority chemical and biochemical parameters in environmental matrices. The Branch also has lead responsibility for analytical quality assurance for most C&P chemical monitoring programs. The major clients for this analytical work include the Institute, the Water Quality Branch National and Regional laboratories, Federal/Provincial Water Quality Agreements, the program on Long Range Transport of Airborne Pollutants, Prairie Provinces Water Board and Great Lakes Water Quality Program.

New knowledge of the dynamics of water is sought to provide a framework for the management of water resources, and for biology and chemistry research in the aquatic environment. The interfaces between water and the atmosphere, bottom sediments, and shore are studied to explain the mechanisms controlling the transport of pollutants and erosion. Advances are made in river metrology to improve management of that resource. The major clients are the Water Resources Branch, Water Planning and Management Branch, Great Lakes Water Quality Program, Environmental Protection, and the Atmospheric Environment Service.

Universities and private industry are encouraged to make use of the Branch facilities and expertise either by collaborative studies with the professional staff or leasing of the facility with or without technical support. The Branch maintains a well equipped hydraulics laboratory, sedimentology and geotechnical laboratories and a special clean and hazardous chemicals laboratory in addition to conventional chemical laboratories. All direct requests from external agencies are cost recovered, in full or in part, in accordance with the Treasury Board Cost Recovery Policy.

RESEARCH AND APPLICATIONS BRANCH

Director's Office

Director

Dr. J. Lawrence,
Analytical Chemistry and Quality Assurance

Science Liason Coordinator

Dr. C.T. Miller,
Environmental Toxicology

Secretaries

Ms. Joyce Burford
Ms. Norma Snelling

Administrative Officer

Ms. Colleen Kennedy

I. ANALYTICAL CHEMISTRY RESEARCH

ANALYTICAL CHEMISTRY RESEARCH

I. Sekerka, B.Sc., Ph.D., Project Chief

SYNOPSIS

The mandate of the project is to advance knowledge and provide expertise on environmental analytical chemistry. The project is essential for the successful management and utilization of water resources and for research on water pollution, especially the identification of emerging problems.

ISSUES AND RATIONALE

Successful solutions to environmental problems require the availability of accurate, precise and rapidly-produced analytical data. Every department program which relies on the collection of data is dependent on the availability of sound chemical methodology.

This project develops and evaluates analytical methodologies (including sample collection, preservation, extraction, pre-concentration, clean-up and analysis) for the measurement of chemical parameters in water, sediment, effluents and biota. Improvements to existing methods in terms of precision, accuracy, detection limits, cost effectiveness, automation and speciation are an integral part of the program.

Project activities include advanced analytical chemistry research as well as methodology suport and transfer to IWD laboratories, NWRI scientists, the GLWQP and other clients.

PROJECT OBJECTIVES

a) To develop new and improved analytical methods as well as screening and sampling procedures which are accurate, and cost-effective, sensitive and unambiguous for the identification and quantification of contaminants in aquatic ecosystems.

b) To play the lead role in documentation, validation and standardization of analytical methodologies to ensure accuracy and reliability of analytical data.

c) To provide a service of sophisticated instrumentation and facilities such as gas chromatography-mass spectrometry and the Clean and Hazardous Chemical Laboratory.

d) To transfer developed methods and technologies to the national and regional laboratories of IWD and to other clients.

RESEARCH PROGRAM

Analytical methods will be developed for organic and inorganic parameters in a variety of environmental substrates. These include state-of-the art techniques such as high performance gas chromatography, high pressure liquid chromatography, emission and absorption spectroscopy, flow-injection analysis, radioimmunoassay and electrochemical techniques. Both broad screening techniques and detailed quantitative techniques will be developed, as well as improved sample collection and extraction techniques.

CURRENT ACTIVITIES:

1. Analytical/Methodological

   a) Implement dense-gas (supercritical fluid) chromatography in tandem with low-resolution mass spectrometry for analyzing priority organic contaminants.
   b) Develop electrochemical and flow-injection analytical methods to improve economy and efficiency of operations in WQB laboratories.
   c) Develop screening methods for interference in sediment and large-volume water concentrates prior to G.C. and capillary G.C. analysis.
   d) Develop clean-up procedures suitable for analysis of dioxins, furans and sulphur-containing compounds.
   e) Develop a method for simultaneous determination of 5 anions and up to 5 cations by ion chromatography.

2. Laboratory Service

   a) Provide the service of the Clean and Hazardous Chemical Laboratory.
   b) Automate and computerize laboratory analytical systems for application in NWQL.

3. Field Samplers

   a) Develop large-sample extractor for field use.

PROJECT CONTACTS:

MANAGER	J. Lawrence	336-4927
PROJECT CHIEF	I. Sekerka	336-4957

CONTACTS	TELEPHONE NO.
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I. Sekerka	4657
B.F. Scott	4596
I. Sekerka	4657
J. Sherry	4926
V. Cheam	4645
H.B. Lee	4645

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84009 DATE: October 1987

TITLE OF STUDY: Post Column Derivatization for HPLC Methodology

STUDY LEADER: H.B. Lee

TEAM: J. Ryan and H.B. Lee

GOALS: 1. To improve a HPLC method for glyphosate in water
2. Technology transfer of chlorophyll method to NWQL

DATE:

October, 1987

A thorough literature search for the existing analytical methods for glyphosate and its major metabolites was done. Because of the high water solubility and polarity of the herbicide, HPLC methods were the preferred technique. However, fluororganic labelling is required for the sensitive detection of glyphosate and both pre-column and post-column derivatization methods have been described. For the HPLC analysis of glyphosate in water, pre-column derivatization with 9-fluoronylmethyl chloroformate (MOC-Cl) appears to offer the most potential because of its speed, simplicity, and sensitivity. A review on the glyphosate methodology has been written.

A new dual wavelength monochromator fluorescence detector was acquired and is being evaluated for the analysis of the herbicide. The estimated detection limit for glyphosate in water samples is about 0.5 ppb (µg/L) without any sample preconcentration. Water samples from Western and Atlantic regions will be used for interference studies.

Publications:

Ryan, J.F., H.B. Lee. 1987. A Review of Analytical Methods for Glyphosate: Application to the Analysis of Water Samples.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84011 DATE: October 1987

TITLE OF STUDY: Negative Ion Chemical Ionization Mass Spectrometry and Supercritical Fluid Chromatography

STUDY LEADER: F. Onuska

TEAM: K. Terry

GOALS:
1. Applicability of supercritical fluid chromatography to non-ionic surfactants, PAHs and pesticides
2. Investigate applications of NICI-MS for analysis of chlorinated contaminants and other compounds

DATE:

October, 1987

1. As the continuation of 85/86 study, we re-designed our inhouse SFC system for capillary column applications by replacing a Brownlee dual micropump with a Lee Scientific large volume piston pump. This pump is computer-driven and provides both pressure and density programming capabilityes. Also, we changed an injection system which at present is automated as far as duration period for a sample introduction. This system represents state-of-the-art in SFC.

   Work has continued on the quantitation of non-ionic surfactants of the alkoxyethoxylate type (Dobanol). A qualitative characterization of a standard and quantitative analysis of water samples has been performed. It is shown that sensitivity of a flame ionization detector is not sufficient for its utilization in environmental analysis of surfactants.

   We initiated to investigte supercritical fluid extraction as a viable alternative to Soxhlet extractor and preliminary work is focussed on a design of the extractor.

2. This part of the study will not be carried out since funds for the negative ion Cl were not received.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84012 DATE: October 1987

TITLE OF STUDY: Preconcentration for Ultra-Trace Analysis

STUDY LEADER: Dr. P.D. Goulden

TEAM: Dr. P.D. Goulden and D.H.J. Anthony

GOALS:
1. Develop processes using Large-Sample Extractor technology in the determination of trace metals.
2. Investigate the chemistry necessary to carry out the in situ derivatization of phenols using the Large-Sample Extractor
3. Modify existing Large-Sample Extractor systems to allow operation in a completely enclosed manner to mininize exposure of personnel to dichloromethane and to provide recovery of solvent from waste effluent.

DATE:
October, 1987

1. Work continues on schedule.
2. The investigation of phenols derivatization using Large-Sample Extractor technology has been ceased.
3. With the granting of additional O/M funds, work has resumed on the incorporation of "environmentally acceptable" features (isolation of extraction process from personnel, solvent recovery) in the Large Sample Extraction systems.
4. The success of a "rush" validation of the 24 hr version of Large-Sample extractor, carried out in April 1987 had led to the permanent set up of these systems as 7-day samplers at NOTL and Ft. Erie by the WQB/OR in response to their commitments to the Niagara River Action Plan.
5. Recently, several groups interested in incorporating Large-Sample Extractors in their operations, have been given demonstrations of LSE operation, information on their construction and applications to which they have been put and tours showing their incorporation in the WQB sampling-extraction-analysis scheme (i.e., NOTL and WQB/NWQL) see progress report 84012, September 18-October 16, 1987; attached.

Reports and Publications

Kuntz, K.W., P.D. Goulden, D.H.J. Anthony and H. Biberhofer. 1987. Sampling and Extraction of Large Volume Water Samples for Environmental Contaminants. Presented at the American Water Resources Association Symposium, Monitoring, Modelling and Mediating. Syracuse, NY, 17-20 May 1987.

McCrea, R., J.D. Fischer, P.D. Goulden and D.H.J. Anthony. 1987. A Sampling System for Monitoring Organics Using a Week-Long Integrated Sample of Sediment and Water; Part 2: Solvent Extraction System. WQB/OR report, Pt. 1, in preparation.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84013 DATE: October 1987

TITLE OF STUDY: Electrochemistry and Flow Injection

STUDY LEADER: I. Sekerka

TEAM: J.F. Lechner, J.S. Ford

GOALS:
1. Develop the system of "in line" preconcentration and/or separation suitable for continuous flow analysis.
2. Automation of FIA including sample presentation.
3. Transfer developed methods (nutrients, Na, K) to NWQL.

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DATE:
October, 1987

1. Work continues on schedule. A simple, inexpensive and flexible cartridge suitable for "in line" preconcentration of ionic species has been designed and tested. It eliminates the problems associated with swelling and shrinking of ion-exchanges resine during loading and eluting processes. Several cation exchanges have been tested and evaluated. Best results were obtained with Chelex 100 resine. Using 2 min. preconcentration and 20 s elution time enrichment factor of one hundred has been achieved. This translates into an improvement of the detection limits for AA detemrination of heavy metals to parts per trilion levels. Its incorporation into ICP system will improve the detection limits to the levels required for precipitation samples.

   Experiments with the application of microwave irradiation of samples containing conplexed ions have been initiated with very promising results. The goal is to develop the system capable of digesting samples in continuous flow mode.

   Tests of preconcentration by continuous flow solvent extraction are in progress.

2. The highest priority in Engineering goes to another Research and Applications Branch project. In effect, the work on the robot and its accessories has been put aside.

   Regardless, in brief intervals in our work schedule, we produced new concepts and procedures for handling bottles which will produce a better system. The latest approach will use standard industrial fixtures as much as possible to reduce costs.

   We found two contractors who might bid on our requests. This assists in keeping the cost down. Writing the purchase specifications is the next step.

...../2

Study No. 84-013 (continued)

The communications circuits connecting the PDP11, the robot and the bar code reader are complete. They passed the first stage of testing. Further testing awaits the other accessories.

These changes of priorities were implemented without a discussion with Study Leader and ACRP Chief.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84014 DATE: October 1987

TITLE OF STUDY: Analysis of Organics in Concentrated Sample

STUDY LEADER: B.F. Scott

TEAM:

GOALS:
1. To develop an HPLC method for cleanup procedures for compounds on interest (OCs, PCBs, organo-sulphur compounds), then quantitate in WQ automated gas chromatography laboratory.
2. Continue transferring toxaphene methodology (detailed evaluation of NWQL automated laboratory).

DATE:
October, 1987

1. Previous work has shown that for dense phases, exclusive of fish, HPLC can be used for cleanup. This involves using micro-styragel for lipid cleanup and a porisil column for the regular silica cleanup. Some instrumentation is now in place, programmable pump and automated switching valves, to facilitate the automation. The only aspect missing is collecting the effluent of the styragel column then introducing it to the top of the porisil column as a plug. This aspect was deemed less important to resolve than the thrust of the project over the past six months. The aspect that has been investigated is the fine-tuning of the detection system so that it can quantitate the compounds of interest in a complex chromatogram with a high degree of accuracy. This involves goal 2 and the last part of item 1.

   To this end, it was decided that for standards which contained organo-chlorine pesticides and chlorobenzenes, the reproducibility should be better than 5% as determined by the coefficient of varience from at least nine separate injections. As in the normal operation of the NWQL, this was to be run in the splitless mode of injection, using capillary columns. The desired degree of reproducibility was achieved after altering the chromatographic conditions, but attempting to leave the integrating parameters constant over the duration of the run. Then other columns of varying polarity were investigated as was the addition of guard columns before the working columns. Except for the last two peaks (methoxychlor and mirex) the CV was about 5% for all columns. These columns included SPB1, SPB5, and SPB608 type columns as well as a thin liquid phase SPB5 type column. Although on some of the columns one or two of the peaks may have co-eluted, the CV value of 5% for splitless mode is better than has been reported in the literature. Serial dilutions were performed on the standards which allowed a check on the linearity of the response of the detector to the particular compound and obtain a value for the minimal detectable amount, defined as three times the noise over baseline. The correlation coefficients

...../2

Study 84014 (continued)

were greater than 0.97, often above 0.99. Also the minimal detectable amounts, which were as low as 10^{-13}g, were a factor of 10 less than usually obtained.

To facilitate the statistical treatment of the data generated from chromatograms, a program was developed to use the capability of the computer controlling the gas chromatographs. This was essential as the next step was to run PCBs (four Arachlor mixtures) and PCBs plus OCs. This produces about 127 peaks, and the transferring of this by hand to another computer for statistical analysis would take several days.

The next step was the chromatography of the PCBs. This required being involved with the technology transfer of the PCB method developed by Dr. F. Onuska. Altering the chromatographic conditions and using a deactivated SPB5 type column, CVs of less than 5% were obtained for at least 60 peaks, some of which are only moderately resolved. Running the OCs on the same program and column also gave CBs of less than 5%. When the PCB mixture was chromatographed with the OC mixture, only three peaks were coeluted and these were minor constituents of the particular Arachlor. Presently, the peak names have been assigned and are undergoing quantitation.

Concurrent to the above, post run programs are being developed that will update standards, use these standards for quantitation and will carry out pattern recognition for those peaks of prime concern, especially those from mixtures such as PCBs and toxaphene.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84016 DATE: October 1987

TITLE OF STUDY: Operation of CHCL and Separation of Organics

STUDY LEADER: I. Sekerka

TEAM: R. Wilkinson

GOALS:
1. Provide the services of CHCL.
2. Develop procedures for simultaneous digestion and sulfur removal.
3. Investigate the application of carbon liquid chromatography for cleanup and separation procedures.

DATE:
October, 1987

1. The services of CHCL to various agencies were provided on as needed basis.

2. Experiments of sulfur removal by digestion with Bi^{3+} are in progress, nothing to report at present.

3. Two kinds of carbon (graphite fibres and porous vitreous carbon) were selected for the experiments. Columns containing these materials were constructed and method of activation was developed. Columns are suitable for GC as well as LC application. Required values of adsorption capacity and intensity were achieved. Experiments with thermal disorption (GC) and solvent elution (LC) are in progess.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84017 DATE: October 1987

TITLE OF STUDY: Radioimmunossay Technique for Dioxins

STUDY LEADER: J.P. Sherry

TEAM: R. Wilkinson

GOALS:
1. Complete development of RIA for detection of PCDDs in aquatic environmental samples.
2. Investigate use of monoclonal antibodies (when available) in the RIA for PCDDs (in collaboration with Stanker group at Lawrence Livermoore National Laboratories, USA).
3. Investigate the use of enzymatic methods for the detection of PCDDs in environmental samples.

DATE:
October, 1987

1. The first set of experiments required for the calibration and validation of the RIA for PCDDs using fish matrices has been completed. An unanticipated delay has occurred in these investigations as a consequence of the deterioration of the hapten reagent during storage. Several attempts to synthesize fresh hapten by labelling a bromo-substituted valeramido derivative of dioxin with ^{125}I proved unsuccessful, even though this reaction offered several theoretical advantages over the standard procedure. It was concluded that in order for the reaction to proceed as anticipated, the reactants would have to be refluxed at 5°C for 24 hours; this was not possible given the levels of radioactivity involved. A fourth batch of 1-N-(5-iodovaleramido)3,7,8-trichlorodibenzo-p-dioxin was then synthesized and characterized using GC, GC/MS, and TLC. This compound has been labelled with ^{125}I, and is currently being characterized using immunoasay procedures.

2. Monoclonal antibodies to TCDD have been obtained and will be evaluated as soon as the RIA is again fully functional.

3. The first report on the RIA for PCDDs is nearly complete. This report contains a description of a previously evaluated version of the assay which can be used as the basis for transferring the method to other users.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84018 DATE: October 1987

TITLE OF STUDY: Development of Methods for Chlorophenols and Chlorinated Anisoles

STUDY LEADER: H.B. Lee

TEAM:

GOALS:
1. To develop a method for chlorophenol analysis in fish homogenate as required by the Fraser River Estuary Management Program.
2. To develop a method for the determination of chlorinated anisoles in water.
3. To develop methods for the analysis of pyrethroids.

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DATE:
October, 1987

A simple and sensitive method for the determination of 19 chloroanisoles (from monochloro to pentachloro) and two chloromethylanisoles was developed for water samples. The method involved dichloromethane extraction, Florisil column cleanup and final analysis using GC-ECD and GC-MSD with suitable capillary columns. Recoveries of chloroanisoles were between 70 and 85% and detection limits were 0.02 ^{e}g/L for mono- and di-chloranisoles and 0.002 ^{e}g/L for the tri-, tetra-, and penta-chloranisoles. Another method for the determination of the above chloroanisoles in sediment samples was also developed. Extraction was performed by a Soxhlet apparatus using a mixture of acetone and hexane. The sediment extracts were then cleaned up and analyzed as described above for the water samples. Detection limits were 0.002 ^{e}g/g for mono- and di-chloroanisoles and 0.001 ^{e}g/g for the higher chlorinated anisoles. In both types of samples, the MSD was used for quantitative and confirmation purposes. A report was written for the above methods.

Several procedures for the extraction of chlorophenols in fish homogenate are being examined. Plans are also made to include the analysis of chloroanisoles into the chlorophenol method. The evaluation of a new GPC solvent system for the removal of fish lipids has also been initiated.

Reports and Publications:

Lee, H.B. 1987. Determination of 21 Chloroanisoles in Water and Sediment Samples. NWRI Report.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84019 DATE: October 1987

TITLE OF STUDY: Method Development for Low Level Cd by IC

STUDY LEADER: V. Cheam

TEAM:

GOAL: 1. To develop an ion chromatographic method for determination of sub ppb level of Cd in water.

DATE:
October, 1987

An ion chromatograph was set up. It consists of an analytical pump, separator column, a post-column reactor and a UV-visible detector. At the initial stage, many interferents were encountered. However, after several experiments using different kinds and combinations of eluents and post-column reagents, an optimum condition was found. A detection limit of 0.1 ppb is attainable and the recovery of an NBS reference material is satisfactory. The study continues and the progress is on time.

Conferences

V. Cheam presented a paper at the 193rd ACS National Meeting in Denver, Colorado, April 5-10, 1987.

V. Cheam attended a European conference, "Euroanalysis VI", held in Paris, on September 7-11, 1987.

Reports and Publications

Cheam, V. and A.S.Y. Chau. 1987. Analysis of Anions, Monoralent and Divalent Cations in Soft Waters. Am. Chem. Soc. (Div. Env. Chem.) 27(1):139-143.

Cheam, V., A.S.Y. Chau and S. Todd. Sulfate in Colored Waters. I. Evaluation of Chromatographic Develkopments in Water Science, Vol. 27, 64-78, 1986.

Cheam, V., and A.S.Y. Chau. 1987. Automated Simultaneous Analysis of Anions, Monovalent and Divalent Cations. Analyst, 112:993-997.

II. QUALITY ASSURANCE

QUALITY ASSURANCE

A.S.Y. Chau, MSc., Project Chief

SYNOPSIS

The mandate of the project is to ensure that chemical data generated for Environment Canada are of good and comparable quality. The project is essential for the successful management and utilization of water resources and for research on water pollution, especially the identification of spatial and temporal trends.

ISSUES AND RATIONALE

Environmental monitoring and assessment programs utilize large quantities of chemical analytical data from a variety of sources. These data must be of acceptable quality and comparable on a regional, national and international basis.

Stringent quality assurance protocols are essential for obtaining valid, precise and representative information about the environmental system under study. The procedures must ensure, and clearly demonstrate, the integrity of samples throughout collection, handling and analysis. Equally stringent procedures must be applied in the area of data management to ensure proper data utilization. Only by collecting and using data within specified tolerance limits can it be assured that spatial and temporal trends are statistically significant or that data from different laboratories are comparable.

Many of the advances in the field of quality assurance impact on the management of science, rather than science itself. Expertise is a human, not a technical resource. Central quality assurance establishments gain in experience over time and provide unique insights, interpretations and advice.

For participating labs, the production of quality data involves the human elements of training, motivation, self-discipline and management. Central interlaboratory quality assurance programs accelerate progress up the learning curve and prevent back-sliding. NWRI provides quality assurance support to over 190 federal, provincial, university and private sector labs.

PROJECT OBJECTIVES

As lead responsibility centre for quality assurance:

a) To plan, coordinate and implement quality assurance and control programs to ensure accuracy, comparability and reliability of analytical data.

b) To prepare and certify standard reference materials (water, sediments and biota) for use in interlaboratory comparison studies, intra-laboratory quality control activities and analytical method research.

PROGRAM

Project activities will include developing management plans for quality assurance, advising on field, laboratory and data-management quality control procedures, preparing standard reference materials, conducting interlaboratory comparisons and conducting quality assurance audits.

Quality assurance studies will be conducted for federal, provincial, university and private laboratories producing analytical data for departmental programs (WQP, LRTAP, PPWB, GLWQP, Fed./Prov. Water Quality Agreements). Methodology evaluation and sample preservation will also be carried out in support of these studies.

Within the Canadian scientific community, innovations in chemistry, biology and ecology have resulted in a wide range of tests and indicators of environmental quality. NWRI is establishing a program in conjunction with the Cost Recoverable Technical Assistance Program at the Department of External Affairs, to marshall this valuable Canadian resource and market it effectively.

The new progrm will increase the market penetration of Canadian private sector environmental consultants and testing laboratories, by making a quality assurance program available on a cost-recovery basis to Canadian companies bidding on contracts with domestic and international development programs.

In addition, marketing arrangements will be developed to make certified reference materials available to the private sector on a cost-recovery basis.

CURRENT ACTIVITIES

a) Upper Great Lake Connecting Channel Studies (UGLCCS). Develop quality assurance strategy and manage an interlaboratory QA program of 13 studies.

b) IJC QA. Design and conduct four multi-level multi-sample interlaboratory studies (Total P in water, organics in fish and sediment and metals in sediments).

c) LRTAP QA. Three multi-level, multi-sample interlaboratory studies for major ions and nutrients and for aluminum speciation.

d) Federal/Provincial Water Quality Monitoring Agreement QA Program and the Prairie Provinces Water Board (PPWQ) QA Program.

Design and conduct six bi-monthly studies for the PPWQ QA, a detailed integrated data evaluation on laboratory performance was also generated.

e) National QA. Design and conduct a national QA study for trace metals in sediment for data and methodology assessment.

f) Sample Stability and Preservation. Evaluate preservation techniques for PAHs, chlorobenzenes and phenoxy acid herbicides in natural water.

PROJECT CONTACTS:

MANAGER	J. Lawrence	336-4927
PROJECT CHIEF:	A. Chau	336-4953

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K.I. Aspila	336-4638
Y. Stokker	336-4638
N. Arafat	336-4645

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84021 DATE: October 1987

TITLE OF STUDY: Organic Quality Assurance

STUDY LEADER: Y.D. Stokker

TEAM:

GOALS:
1. To develop a new organic certified reference material for sediment (No. EC-6) and one for fish to support ongoing and new QA programs.
2. To evaluate the stability of chlorophenols, OCs and PAHs in fish homogenates and PCBs, CBs, OCs and PAHs in fortified sediments.
3. To generate reference values for new organic parameters (OCs) for 2 or 3 existing CRMs.
4. To conduct interlaboratory studies for the Federal Interdepartmental Committee on Pesticides (FICP) and Fraser River Projects and to initiate interregional QC studies for organics.

DATE:
October, 1987

Please Note: Due to a reduction in resources (from 2.3 PY to 1.3PY) some of the above goals in this study will not be met.

The development of two new organic sediment reference materials has been initiated by conducting preliminary screening analyses for selected organic parameters. Reference materials EC-6 and EC-7 are freeze-dried sub-samples of sediments collected from Lake Erie and Lake St. Clair, respectively.

The first phase of a sediment mixing study was successfully completed by the evaluation of the levels of PAHs, PCBs and chlorobenzenes in 3 blended and 4 freeze-dried CRM sediments. The second phase of this study, to generate reference values for OCs in these same 7 sediments, has been initiated.

The stability of chlorophenols in fish homogenates has been evaluated and a report has been drafted. Due to the loss of human resources, however, evaluation of the stability of selected organic parameters in sediments will not be pursued this fiscal year.

An interlaboratory FICP study on the analysis of chlorophenols in water is nearing completion. Of an initial 23 participants, only 10 laboratories have submitted results to date.

A National QC study has also been initiated on the analysis of Aldicarb and its metabolites in ground water samples to meet the requests of Water Quality Branch, Atlantic Region and the Groundwater Contaminants Group of Rivers Research Branch, NWRI. Water samples and standard solutions have been sent to 23 participating laboratories across Canada with an anticipated closing date for this study of December 1987.

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Study 84021 (continued)

Four methods developed by this section have been submitted to the National Water Quality Laboratory for inclusion in the IWD Analytical Methods Manual as follows:

a) Method for the Analysis of Dinoseb in Natural Waters by in situ Acetylation (NWRI Contribution No. 87-61).
b) Method for the Analysis of Nitrophenols in Natural Waters (NWRI Contribution No. 87-62).
c) Method for the Analysis of Nitrophenols in Sediments (NWRI Contribution No. 86-60).
d) Multi-Class, Multi-Residue Method for the Analysis of OCs, PCBs, Chlorobenzenes and Neutral Herbicides in Sediments (NWRI Contribution (87-121).

Technology Transfer to the National Water Quality Laboratory of the methodology for the analysis of chlorophenols in sediment is currently in progress.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84022 DATE: October 1987

TITLE OF STUDY: Development of a Sediment Reference Material for Heavy Metals and Major Ions

STUDY LEADER: V. Cheam

TEAM:

GOAL: To develop a sediment reference material and generate preliminary reference values for Co, Ni, Zn, Fe, Mn, Ca, Mg, C and N.

DATE:
October, 1987

Diversity of research areas demands diversity of Reference Materials (RMs) in matrices as well as in concentration levels. Great Lakes research demands Great Lakes RMs. Our RMs are being and will be used by the scientists of NWRI, WQL and many outside agencies. The development of more sediment Great Lakes RMs helps fulfill the diversity requirement.

Several bulk sediments were screened and one was selected for this project based on its useful concentration ranges of Co, Ni, Zn, Fe, Mn, Ca, Mg, C and N.

Inhouse data as well as those from contract laboratory and NWQL are being evaluated.

Three sediment mixings were made using EC-1, EC-2, EC-3, WQB-1 and SUD sediment reference materials. Analyses are being carried out.

The final report of the National Interlaboratory Study No. 35 (trace metals in sediments) has been sent to over 40 participants.

Reports and Publications

Cheam, V., A.S.Y. Chau and W. Horne. 1987. National Interlaboratory Quality Control Study No. 35: Trace Metals in Sediments. NWRI Contribution No. 86-223.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84023 DATE: October 1987

TITLE OF STUDY: PPWB and Fed/Prov. Quality Assurance (QA) Program

STUDY LEADER: H. Alkema

TEAM: H. Alkema and A.S.Y. Chau

GOALS:
1. To ensure that data generated by Federal, PPWB (Prairie Province Water Board) and Quebec, British Columbia, New Brunswick and a Northern Affairs Program (NAP) laboratory are of good and comparable quality.
2. To complete two quality control studies for the above three programs every two months.

DATE:
October, 1987

This project responds to the mandates of the PPWB and the requirements of the Federal-Provincial Agreements on Water Quality. Laboratories in these programs produce chemical data for health and environmental concerns, for Environment Canada and for those provinces that have Water Quality Agreements with the Federal Government. Constituents in this project are extensive (trace metals, major ions, nutrients and physical parameters). Program data for which this project addresses, is compiled in NAQUADAT. NAQUADAT has a very large list of data users.

Eight preliminary data reports were completed and communicated to the thirteen participating laboratory Heads. (The Quebec laboratories received a French version).

Nine final reports were written and sent to the laboratory and program managers of PPWB, Fed/Prov. and NAP. These reports were IR148-9, IR150-1, IR152-3 (also to NAP), PP53-4, PP55-6, PP57-8, FP13-14, FP15-6, FP17-8. The last three reports were in French and sent to the appropriate Quebec agencies and to Headquarters.

Six QC studies were distributed to IR, PP, FP and NAP participants. These studies dealt with trace metals, major ions, nutrients and physical parameters in surface waters or standard reference waters.

One compiled report was completed, namely: Summary Report FPQC Studies 7-18 (Rapport Sommaire PAQFP, 7-18), (compiled report NWRI Contribution 87-124 in English and French).

One reference sample (RM) was designed, prepared and tested. This sample will compliment QC test samples for the PPWB QA program necessary for long-term laboratory performance evaluation.

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Study No. 84023 (continued)

Computer programming is in progess to convert the PPWB sequential data base into a hierarchical one (System 2000). This data base is designed to allow quick access to data and easy transfer of data between QAS data bases. Other QA programs interested in these refernce values or specific laboratory results would include IJC, LRTAP and UALCCS as well as individual laboratories in the FP and PPWB QA programs.

Another laboratory, the NB Environmental Laboratory, has joined the Fed/Prov. QC program under the Fed/Prov. Agreements. This makes the thirteenth laboratory that participates in the three QA programs.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84024 DATE: October 1987

TITLE OF STUDY: Quality Assurance Program - UGLCCS

STUDY LEADER: A.S.Y. Chau

TEAM: W. Li and E.

GOALS: To serve as the chairman of a Quality Management Work Group for UGLCCS; to plan, develop and coordinate activities relating to quality assurance and to manage an interlaboratory QA program.

DATE:
October, 1987

1. Thirteen interlaboratory QC studies were conducted. For each study, two interim reports were sent. Five final reports for QM-3 to QM-8 were done and received internal approval to be sent out. Final reports for QM-9 to QM-11 have been drafted and are being reviewed.

2. Advice was given to both the Management Committee and the Activity Integration Committee on laboratory performance and to another work group chairman regarding the write-up of data quality in their final reports.

3. There was an approximate two-month interruption in schedule due to personnel changeover.

Financial Status

Allocated: 50.0 UGLCC/GLWQP
55.0 UGLCC/EPA

All funding is committed for two contract persons.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84025 DATE: October 1987

TITLE OF STUDY: LRTAP Interlaboratory Quality Control Studies (Aqueous Phase)

STUDY LEADER: K.I. Aspila

TEAM: A.S.Y. Chau

GOAL: To define and improve the quality of data generated by laboratories participating in the LRTAP program.

DATE:
October, 1987

This ongoing project was designed to provide three interlaboratory comparison studies/year to laboratories that analze aqueous samples in support of the Federal-Provincial LRTAP. The three studies L-15, L-16 and L-17 are identified below in the Table.

Results of interlaboratory data were appraised for bias by the nonparametric rank order method of Youden. Individual sample results deviating significantly from interlaboratory medians were flagged either high or low. Information on very low frequencies of bias and flags, over several studies, has allowed some labs to be categorized as satisfactory. A few laboratories, very frequently flagged and very frequently biased, are considered poor in these peer group appraisals. Individual managers are informed of their ratings.

Studies were distributed and completed within 16 weeks, during which each participant was provided a lab specific performance appraisal. Participants with poor appraisals wereexpected to take corrective action. Formal study reports for distribution through the LLO are prepared afterwards.

Work continues on:

a) The preparation of reference water specific to the LRTAP program.
b) Refinement and expansion of existing computer programs.
c) Analysis of the stability and homogeneity of reference waters.
d) Liaison with analysts, managers and users of LRTAP data.

Achievements

1. Two of the three scheduled studies have been completed (details are in the table below).
2. The very extensive data base for LRTAP studies L-1 to L-15 have been archived into a System 2000 format for retrieval. Several programs have been prepared to highlight performance and demonstrate the value of the data base to management and users of data.

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Study 84025 (continued)

3. The rapid turn-around time between presenting test samples and the interpretation of interlaboratory results has allowed laboratories with bias in their measurement process to take corrective action and improve their analysis.

Study	Distribution of Study	Closing Date	Design	No. of Samples	No. of Participants Expected	No. of Participants with data
L15	April '87	July '87	Major Ions	10	48	44
L16	Aug. '87	Oct. '87	Major Ions	10	52	19
L17	Dec. '87	Feb. '88	Major Ions	10	(study is being developed)	

Reports and Publications:

Summary reports have been provided to all participants. Formal reports for publication are being drafted for review.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84026 DATE: October 1987

TITLE OF STUDY: IJC Quality Control (Interlaboratory Studies)

STUDY LEADER: K. I. Aspila

TEAM:

GOAL: To provide three interlaboratory quality control comparison studies to laboratories in the Great Lakes Basin that support the Canada/US Great Lakes Water Quality Agreement

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DATE:
October, 1987

This project provides interlaboratory quality assurance studies to those laboratories directly or indirectly involved in the Great Lake International Surveillance Program. The studies are prepared and distributed by NWRI with some costs recovered ($25 K) through budget allocations from DOE and US EPA. The selection of studies substrates and parameters) are made through consultation with both the Data Quality Work Group and Surveillance Work Group members. Efforts are made to deliver three studies per year. Study data are interpreted by IJC Great Lakes Regional Office staff and the Data Quality Work Group.

Studies consist of a mixture of natural and synthetic substrates. Results for laboratory data sets are interpreted for measurement bias by the rank-order method of Youden. Results on individual samples are flagged high or low when they deviate significantly from interlaboratory median values. When studies are completed, performance appraisals are provided to each laboratory head and pertinent managers. This distribution of laboratory appraisals now includes members of the Water Quality Board.

In 1985 the data evaluation process was expanded to include graphics and a more powerful process to discern bias using the Wilcoxan rank sum techniques.

III. HYDRAULICS STUDIES

HYDRAULICS STUDIES

M.G. Skafel, Ph.D. P. Eng., Project Chief

SYNOPSIS

The mandate of the project is to advance knowledge and to provide expertise and support on the dynamics of water and its interactions with the air, shores, and river and lake beds. The output of the project supports the management of water resources directly such as through its research in: river and sediment metrology; in the transfer of pollutants across the air-water interface; in the energy transfer between air and water; in the generation and propagation of waves and their interactions with shorelines, and indirectly by providing a framework for aquatic biology and chemistry research. Access to its expertise and hydraulics laboratory facilities are being maximized through the development of marketing strategies.

ISSUES AND RATIONALE

To make informed decisions, water resource managers require an understanding of the interaction of water with air and with the sediment and shores in lakes, rivers, diversion systems and on coasts. Scientifically sound and up-to-date methods of flow and sediment transport measurements are vital to successful monitoring of water resources and the pollutants in sediment. Knowledge of the rates of transfer of pollutants between water and the atmosphere is needed to evaluate the significance of "Toxic Rain" on the quality of lake water.

Management of water resources in lakes and coastal regions must be founded on knowledge of the interactions of the water with its boundaries. Surface waves play a dominant role at the air-water boundary where wind energy is transferred to the water.

New knowledge is required to address the issue of resuspension and transport, primarily by wave action, of polluted bottom sediments. Shore erosion and the integrity of shore structures are issues of particular concern during periods of high water levels on the Great Lakes.

Increased environmental concerns and the high cost of water resource developments demand the best possible planning. Reliable predictions of the effects of proposed water projects require computer simulation models with firm scientific foundations.

New technological developments must continue to serve the dual public interest of economic prosperity and the overall quality of life, over the long term. Technological development can only be sustained if economic and environmental factors are considered together at the planning stage of technological innovation.

As a pilot project, the Hydraulics Laboratory is adapting MOSST's generic five-point strategy for science to meet the challenge of sustainable development:

1. Develop intellectual capital. (Centre of Expertise)
2. Develop new knowledge and technologies relevant to priority issues. (Directed Research)
3. Support industrial innovation and technology diffusion. (Technology Transfer)
4. Strengthen the impact of federal R & D. (Marketing)
5. Develop an informed public. (Science Communication)

By making first-class expertise and facilities accessible, environmental and economic forecasting become more predictable and legitimate, entrepreneurs in the economic sector recognize (and realize) the advantages of sound environmental planning, environmental considerations are included in the decisions made by private enterprise, and environmental industries grow.

PROJECT OBJECTIVES

To develop expertise and knowledge in wave mechanics, coastal and fluvial engineering and to communicate new scientific findings developed at NWRI and elsewhere to managers and engineers in Environment Canada, clients, Canadian water managers, and the scientific community at large.

To produce theories, methods and models to permit reliable analyses and predictions of the physical effects relating to natural processes or man-made intervention in rivers and lakes.

To operate the Hydraulics Laboratory in an efficient and effective manner and to provide technical support to scientists using the facilities.

To respond to client requests consistent with longer term strategic research, and to develop policies and programs to increase the use of laboratories where the equipment is not readily available elsewhere, particularly in the private sector.

RESEARCH PROGRAMME

The research programme in wave mechanics creates new knowledge on the accurate parameterization of fluxes of mass, momentum, energy, and heat across the air/water interface. This work has direct consequences in understanding toxic gas transfer, diffusion of pollutants, wave prediction, lake circulation, seasonal thermocline development, weather forecasting and climatic change.

The coastal engineering programme addresses the questions of bottom interactions such as the resuspension of cohesive (polluted) sediments by waves, hindcasting techniques used to develop climatic data on sediment resuspension and shoreline evolution, and wave-structure interaction especially in regard to situations where structural failure could lead to serious environmental consequences.

The fluvial engineering programme is directed at improved understanding of the fluid mechanics and sediment transport of rivers and the development of new and improved techniques for monitoring river processes. Emphasis is placed on providing information for operational branches in Environment Canada. Results are often applicable to issues in other departments and to other water resource managers.

CURRENT ACTIVITIES

Wave Mechanics

A new wind-wave flume is being prepared to examine the mechanisms of toxic gas transfer at the air-water interface. The analysis of Lake St. Clair wave data is being completed and the new findings will be incorporated into the NWRI wave prediction model. The final phase of the field measurements addressing the topics of wave orbital velocities, turbulence and mixing in a whitecapping sea will be completed and analysis of the data continued. Analysis of field and laboratory data will continue aimed at elucidating the mechanisms for transfer of mass, momentum, and energy between air and water. Theoretical analysis of the energy balance of wind waves and the implications for satellite remote sensing continues.

Coastal Engineering

Data on the wave resuspension of Lake St. Clair bottom sediment is being analyzed and incorporated into a model for resuspension of cohesive sediment. The impact of a new breakwater at Goderich on the littoral processes is being assessed. Field experiments to verify a procedure to obtain the joint distribution of wave heights and periods in shoaling water will be conducted. The two-dimensional NWRI wave prediction model will be incorporated into a wave climate model and this technology transferred to the private sector. Validation of pressure transducer techniques for wave measurement will be done, using field data.

Fluvial Engineering

Applied research is being conducted in support of Water Resources Branch programmes. The evaluation of discharge measurement schemes for the Milk River will be completed. Optimum sampling procedures for bed load measurements will be determined, and dune dynamics will be defined. The effect of turbulence on current meter response will be documented. A reliable method of measuring river flow for irregular bed profiles will be established. A prediction procedure for the critical shear stress for

non-uniform grain size bed material will be developed. Applied research is also being conducted on streambed erosion protection in cooperation with the private sector.

Marketing

In 1987-88 Environment Canada jointly with Treasury Board is contracting the services of expert consultants to explore marketing strategies for the Hydraulics Laboratory and new arrangements with the private sector to facilitate private sector access to this national centre of expertise.

Technical Services

The technical staff operate the facilities in the hydraulics, sedimentology and geotechnical laboratories and provide specialized support to the professional users of the laboratories on an ongoing basis, and to cost recovery projects. The National Calibration Service Unit calibrates and repairs current meters and operates the towing tank facility for the Institute, Water Resources Branch, and users in the private sector. New equipment is being incorporated into the operation of the laboratories: a new settling tube for sediment size analysis and a new micro-computer based data acquisition system for the wind-wave flume.

PROJECT CONTACTS:

MANAGER	J. Lawrence	336-4927
PROJECT CHIEF	M. Skafel	336-4736

CONTACTS	TELEPHONE NO.
M. Donelan	336-4879
C. Bishop	336-4886
P. Engel	336-4737
N. DeZeeuw	336-4733

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84031 DATE: October 1987

TITLE OF STUDY: Hydraulics Laboratory Public Relations

STUDY LEADER: C.T. Bishop

TEAM: C. DeZeeuw, M. Skafel and P. Engel

GOAL: Increase use of laboratory facilities and expertise by both the private sector and other public sector agencies. Strengthen NWRI ties with universities.

DATE:

October, 1987

A six page foldout brochure has been designed to describe the Hydraulics Laboratory. All text and art work have been completed and the brochure is being printed. Inserts providing details on equipment, rental rates and personnel have been drafted and are being translated. The brochures will be ready in November.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84032 DATE: October 1987

TITLE OF STUDY: Fluvial Engineering

STUDY LEADER: P. Engel.

TEAM:

GOAL: To develop methods of flow and sediment transport measurements in open channel flow and to guide and advise resources engineers and managers on technical developments relevant to fluvial engineering.

DATE:

October, 1987

The AFFRA Acoustic Flow Meter:

The first phase of a joint study with Water Survey of Canada (WSC) to evaluate this acoustic flow meter in the towing tank was completed. The meter is being developed by WSC for river discharge measurement applications. A preliminary report entitled "Preliminary Evaluation of the AFFRA Acoustic Flow Meter" has been submitted to WSC.

Flow Measurement Alternatives:

Work is continuing on the Milk River study. Data on stage-discharge curves for different approach channel conditions are being analyzed. A weir design which is hoped to be suitable for prototype applications is currently undergoing tests.

Water Level Measuring Devices:

Work is continuing on the evaluation of different ways of measuring water levels for open channel flow. Work has been completed on float type water level recorders and a report entitled "Performance of Float Actuated Water Level Recording Systems" has been submitted to WSC. A theoretical equation has been developed which will be used to compute the water column elevation from the total pressure recorded with pressure transducers used with gas-purge systems. A report is being prepared for the Water Survey of Canada.

Bed Load Transport in Rivers:

A discussion entitled: "Bed Load Transport in Gravel Bed Streams" has been accepted for publication in the Journal of Hydrauiic Engineering of the American Society of Civil Engineers.

RESEARCH AND APPLICATIONS BRANCH

Study Progress Report

STUDY NO: 84033 DATE: October 1987

TITLE OF STUDY: Coastal Engineering

STUDY LEADER: M. Skafel

TEAM: C. Bishop and M. Donelan

GOAL: To develop methods to predict the effects of waves on shorelines and structures especially under changing water level conditions, and to guide and advise water and coastal zone managers on developments relevant to the nearshore zone.

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DATE:

October, 1987

The analysis of the impact of a new breakwater on the littoral processes at Goderich has been completed and a report prepared.

A report has been completed which reviews the Shore Protection Manual's Wave prediction procedure.

Laboratory experiments to establish wave forces on submarine pipelines in trenches have been suspended pending modifications to the instrumentation. The flex elements on which the strain gauges are mounted slip under normal operations. These will be pinned and tested.

A reporte reviewing all pertinent literature on Great Lakes water levels has been prepared for Public Works Canada.

Technical asssistance and advice has been given to the Ontario Ministry of Natural Resources Hazard Land Technical Committee. Wave runup was calculated at 85 cross-sections for the lower Great Lakes.

Public seminars on Shore Protection Alternatives was held at Kincardine, West Lake, Owen Sound, Bellevile and Goderich.

Evaluation of wave climate models continued. The SMB, JONSWAP, and Donelan similarity steady state equations have been tested against field data from Lake Ontario and the Gulf of St. Lawrence. These methods within one model have been intercompared against data from the model used by Public Works Canada. Work was started to adapt the Donelan parametric model to run in a wave climate mode.

Assistance was given to Parks Canada on a study to seek long term solutions to erosion at the northeast corner of Point Pelee National Park.

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Study No. 84033 (continued)

The analysis of suspended sediment and corresponding wave data from the field experiment in Lake St. Clair was completed. A report has been drafted. Work is underway to incorporate these data into the resuspension models of Simons and Schertzer.

Work has been initiated to examine the joint distribution of wave heights and periods in shoaling waters. Most of the effort went into preparing for the field experiments. These will coincide with field work in wave mechanics so that each will benefit from the other's data. The emphasis here is on the joint distribution of wave heights and periods in shoaling water. This information is extremely valuable to offshore and coastal engineers and helps us deal with erosion of coastal areas. The experimental set up consists of three towers inshore of the WAVES tower in 8m, 4m, and 2m of water. These are installed and are being instrumented.

Accepted for Publication:

Bishop, C.T. Wave Attenuation by Rubble-Lined Channel Walls. Canadian Journal of Civil Engineering.

Bishop, C.T. and M.A. Donelan. Measuring Waves with Pressure Transducers. Coastal Engineering. Also presented at the Canadian Coastal Conference 1987.

Nece, R., E. Nelson, and C.T. Bishop. Some North American Experience with Floating Breakwaters. Breakwaters '88 Conference, Institution of Civil Engineers.

Papers Presented

Skafel, M.G. and M.A. Donelan. Settling and Resuspension of Fine Sediments by Waves. Canadian Coastal Conference 1987.

Skafel, M.G. and C.T. Bishop. Wave Climate Modelling and Intercomparison.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84034 DATE: October 1987

TITLE OF STUDY: Wave Mechanics

STUDY LEADER: M. Donelan

TEAM: M. Skafel, I. Tsannis, K. Kahma, WHOI staff, NRL staff

GOAL: To discover or develop theories and/or models to describe and predict the interaction of wind and water, including surface waves; flumes of mass and energy; turbulence; orbital velocity beneath breaking waves.

DATE:
October, 1987

This is the last field season in the current collaboration on wave-turbulence interaction and radar scattering with the Woods Hole Oceanographic Institution and the U.S. Naval Research Laboratories. A great deal of effort (scientific, engineering, technical, programming) has gone into preparing the wave follower system. This is now operational and was installed on the tower the week of 5 October. It passed the performance tests with flying colours and promises to help us get some very valuable information on wave generation and decay and mixing just beneath the surface.

Further technical work on preparing a rotating/tilting support for the NRL radars is also almost complete. All costs indicated with this last will be paid for by NASA - the results of the radar experiments are expected to be of great benefit to the satellite sensing of ocean winds and ultimately to weather and climate forecasting.

The field season will run from October 14 to December 7.

Reports and Publications

Donelan, M.A. and W.J. Pierson. Radar Scattering and Equilibrium Ranges in Wind-Generated Waves with Application to Scatterometry. JGR, May 1987.

Pierson, W.J., M.A. Donelan and W.H. Hui. Linear and Nonlinear Propagation of Wave Groups. Submitted to JFM, August 1987.

Venkatesh, S., M.A. Donelan, H. Grebar, P. Liu, D. Schwab and M.A. Skafel. Finite Depth Wind Waves - A Preliminary Study on Lake St. Clair. To be published in the preprint volume of the American Meteor. Soc. 7th Conference on Ocean-Atmos. Interaction. January 1988.

Donelan, M.A. and W.J. Pierson. A New Model for Scatterometry Based on an Energy Balance in the High Wave Number Spectrum of the Bragg Waves. Presented at the 1987 IGARS (Intl. Geoscience and Remote Sensing) Symposium, Ann Arbor, MI, May 1987.

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Study No. 84-34 (continued)

Li, J.C., W.H. Hui, and M.A. Donelan. Effects of Velocity Shear on the Stability of Surface Deep Water Wave Trains. Presented at the IUTAM (Intl. Union of Theoretical and Applied Mechanics) meeting on Non-Linear Waves, Tokyo, August '87. To be published in the proceedings of that meeting, and to be submitted to the JFM in expanded form.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84035 DATE: October 1987

TITLE OF STUDY: Transfer of Toxic Gases

STUDY LEADER: M. Donelan

TEAM: N. Merzi and W. Strachan

GOAL: To establish the dependence of the transfer of gases at the air-water interface on the descriptions of the interface.

DATE:
October, 1987

A new wind tunnel has been designed and a contract awarded for its construction. Construction will begin at the end of October and the tunnel will be ready for use at the start of 1988. Design and manufacture of various monitoring instruments is in progress. This tunnel will have and highly accurate instrumentation to facilitate the study of the mechanics and rates of transfer of gases across the air-water interface. We expect to be able to add significantly to the present state of understanding of gas transfer, particularly the aspects pertaining to cross-media pollution.

Reports and Publications

Merzi, N. and M.A. Donelan. 1987. Gas Transfer at Air-Water Interfaces. Internal report - a review.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84036 DATE: October 1987

TITLE OF STUDY: National Calibration Service

STUDY LEADER: C. DeZeeuw

TEAM: D. Fekyt, C. Bil, B. Near

GOAL: Calibration and performance testing of water current meters, sediment measuring apparatus, and other hydrometric equipment used for data collection purposes.

DATE:
October, 1987

232 current meters were calibrated and repaired as necessary for the Water Survey of Canada. Calibrations for third parties have generated about $27,500 revenue. Planned downtime for tow carriage maintenance this winter will have a major impact on operations and various options are being assessed to minimize the disruption of service.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84037 DATE: October 1987

TITLE OF STUDY: Hydraulics and Sedimentology Laboratory Support

STUDY LEADER: C. DeZeeuw

TEAM: G. Voros, R. Klainka, G. Duncan, K. Salisbury, J. Dalton

GOAL: To provide expert technical support staff and fully operational laboratories and equipment for hydraulic geotechnical research and related activities.

DATE:
October, 1987

The annual lab equipment maintenance program has been completed. The motor-generator set providing DC to the tow carriage has been completely overhauled for the first time since its installation. The three pumps for the main water supply to the lab have been overhauled due to corrosion.

All technical support is on schedule. Due to some flexibility in time available and the need to provide technical support, we are providing input to the new re-circulating flume for gas transfer studies.

The Sedimentology/Geotechnology Laboratories are in full production. The X-Radiography System was reinstalled in Room L560 to x-ray cores from Hamilton Harbour (Rukavina, LRB) and Lake Erie (Zeman, LRB). A total of 296 analyses were completed during the period June 1st to October 1st, 1987. Lab production is on schedule.

RESEARCH AND APPLICATIONS BRANCH
Study Progress Report

STUDY NO: 84038 DATE: October 1987

TITLE OF STUDY: Applied Research and Engineering

STUDY LEADER: C. DeZeeuw

TEAM: Scientific, Engineering and Technical Staff in RAB & RRB

GOAL: To maximize the development of new technology and technology transfer by making the Hydraulic Laboratory more accessible to Canadian private sector industries, municipal and provincial governments, and other federal departments

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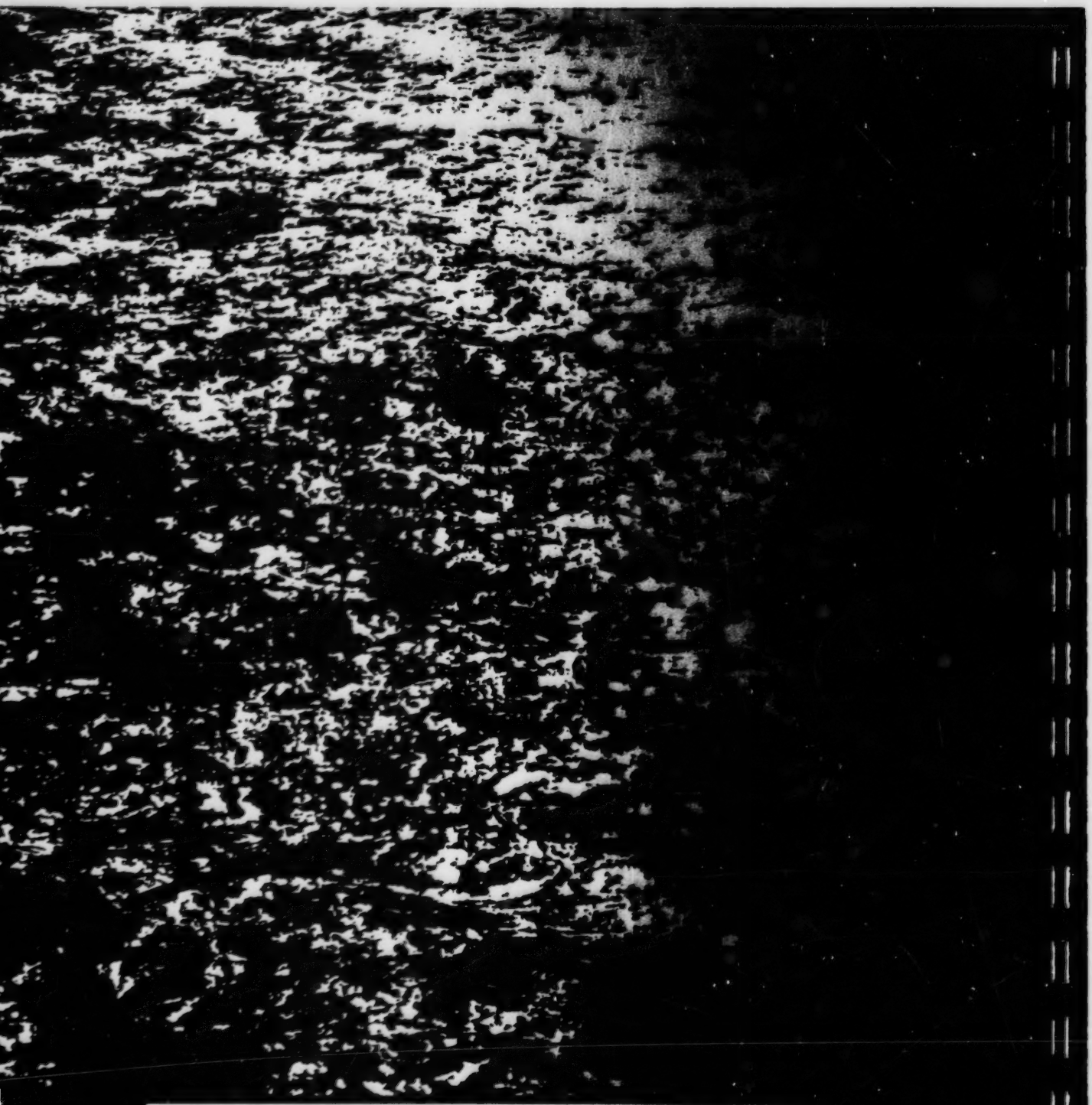
DATE:
October, 1987

This study is the umbrella study for all third party revenue jobs in the Project. Todate some $72,000 has been earned and work in progress is valued at about $48,000. A large contract was received from Hydro Quebec to calibrate current meters, and has been completed.

A contract was completed to evaluate a stream bed protection system for AGS Ltd.

An experimental study to determine the friction factor and the critical velocity for a stream bed protection system marketed in Canada and the United States was completed in the 1 m flume of the Hydraulics Laboratory. The report was submitted to the client and was very well received. The report is entitled: "Flow Resistance and Critical Flow Velocities for the GEOWEB Erosion Control System".



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